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Atmospheric Emissions from Lead Typesetting Operations: Screening Study

PEDCo-Environmental, Inc.
Cincinnati, OH

Prepared for

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ATMOSPHERIC EMISSIONS FROM LEAD TYPESETTING OPERATIONS

- SCREENING STUDY -

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Prepared for

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ABSTRACT

Atmospheric emissions from hot-metal typesetting operations are investigated in this screening study. Three letterpress printing processes entail the use of hot metal: linotype, monotype, and stereotype. These processes are described and potential emission sources identified. Techniques for control of emissions include use of Roto-clones, wet scrubbers, filters, and electrostatic precipitators. Estimated capital costs and annualized operating and maintenance costs of these devices are presented. Three hot-metal printing operations in which emissions are well-controlled are described in detail. Annual estimates of total nationwide emissions from hot metal printing amount to approximately 1370 tons of particulate including 480 tons of lead. It is projected that no new hot metal type printing facilities will start operation and that emissions of lead from the printing industry will steadily decrease by about 8 percent per year until 1986. Due to the relatively low lead emission rate, and the declining utilization of hot lead in printing, further study of this industry with the objective of developing air emission standards is not recommended.

1.0 INTRODUCTION

A screening study of hot-metal typesetting processes was undertaken to indicate the potential air pollution impact of these processes and determine whether further study is required to define the atmospheric potential of the lead type industry. To obtain information for this study, PEDCo contacted most of the larger printing companies in the United States, visited three well-controlled hot metal type operations, consulted industry representatives and control equipment manufacturers, and surveyed the pertinent literature.

Hot metal operations utilizing atmospheric emission controls were identified by use of newspaper and periodical directories, and by calling many of the plants listed as lead type users. Some of these plants had switched to cold typesetting methods and thus eliminated potential emission problems. Three plants were selected for inspection because they incorporate a variety of the emission controls currently used on hot metal processes: low-voltage electrostatic precipitators, fabric filters, Roto-clones,® and wet

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scrubbers. Potential pollution sources and hot metal operations were observed at each plant. Additional contacts were made with printing industry experts and lead type vendors to obtain information from which to project trends in hot metal typesetting operations. Source test data from hot metal operations were obtained from various State air pollution control agencies and the U.S. Government Printing Office.

2.0 INDUSTRY DESCRIPTION

The chief methods of printing in use today are gravure, photostatic, offset, and letterpress. Letterpress methods include the use of hot metal (lead type), plastic plate, and di-litho (use of lithographic plates on letterpress equipment). This report discusses generation and control of emissions from processes using lead type.

Lead type is used primarily in the letterpress segment of the printing industry. The lead typemaking processes are classified according to the procedures involved in producing the final composed matter: linotype, monotype, and stereotype.

In most operations, these processes are used together. Linotype and monotype processes are used to make a mold (see Chapter 3), and the stereotype process is used to produce a plate for printing.

All hot-metal typemaking processes are closed-cycle processes involving essentially the same principle: type is cast from a molten lead alloy and is remelted after printing. A small amount of virgin metal is added periodically to the melting pot to adjust the alloy and to fill make-up

requirements. Though the information is old and perhaps of questionable validity, one plant reported a loss of 127 pounds of metal by drossing* (1.5%) after remelting 9000 pounds of metal 11 times.[1] This is an average metal loss of 0.13 percent per melt.

2.1 TYPE METAL

All type metal is an alloy consisting mainly of lead with much smaller amounts of antimony and tin. Each constituent provides a desired metallurgical characteristic for a slug (a solid bar with raised letters in a line) or other form of type-casting. The metal must cast easily, and when cold must retain form and dimension while giving a sharp reproduction. It must be strong enough to resist distortion under reasonable pressure and hard enough to withstand the abrasion of paper and ink. The alloy must run freely and must not clog the small casting apertures in the metal pot mouthpiece.

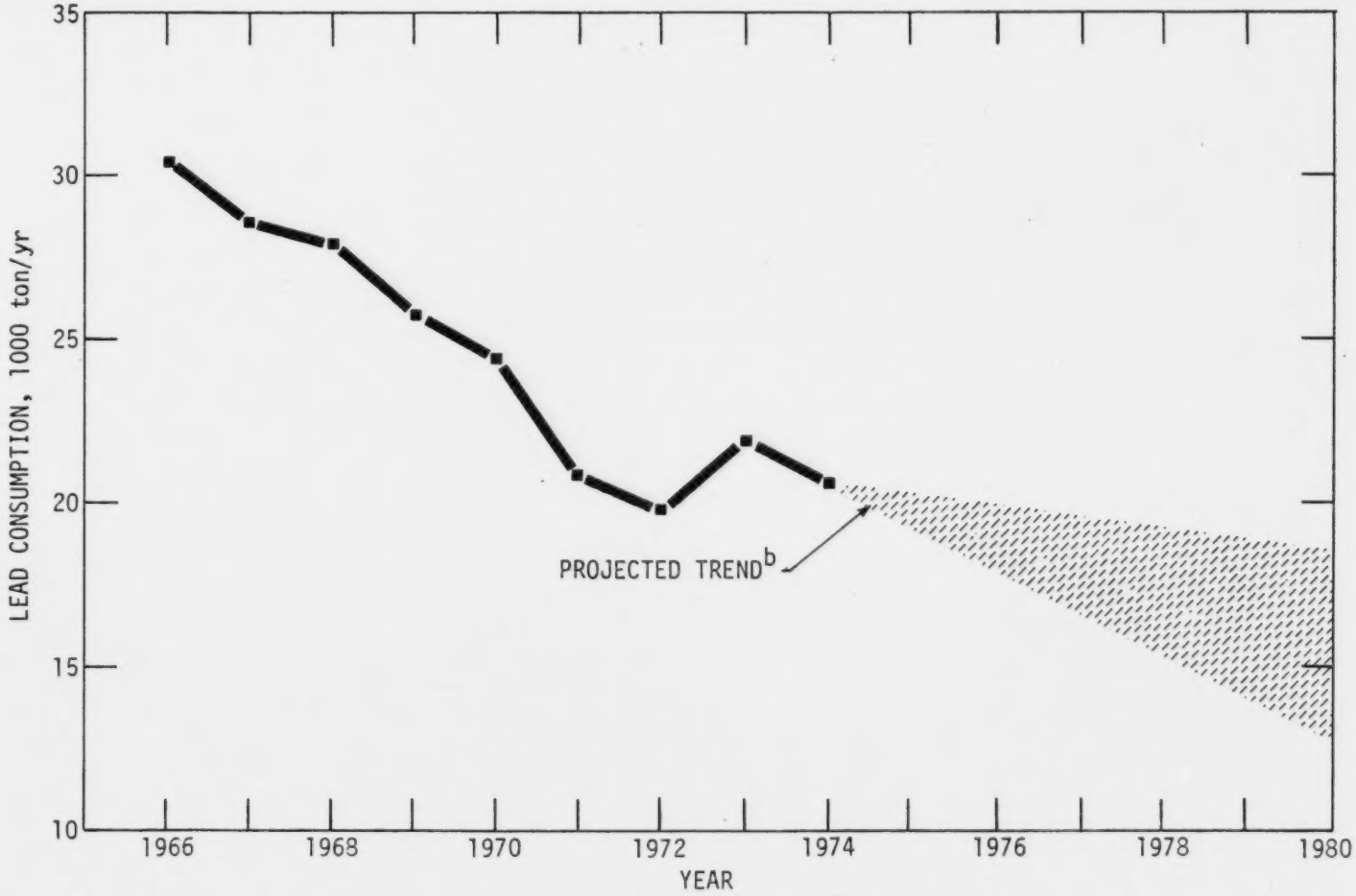
Lead constitutes 60 to 85 percent of the type metal because it has a low melting point. Antimony lends hardness to the alloy and minimizes contraction as the metal cools. The antimony expands as the slug solidifies, providing a clear type face. Tin gives both strength and fluidity to the type metal. It improves the body of the slug by helping the lead and antimony combine more closely, and provides a smooth and even surface to the slug.

*Drossing is the removal of the surface layer of melted metal which contains impurities.

2.2 INDUSTRY TRENDS

Use of lead-based alloys in the typesetting industry has decreased by about 34 percent in the last 10 years, mainly because of the introduction of various photostatic printing processes. Figure 2-1 shows recent trends in consumption of lead for type metal. The figure shows that lead consumption has decreased by an average of 4 to 5 percent per year over the past 8 years and is now down to a rate of 20,000 tons per year.[2] A significant but unknown portion of this consumption is for alloys that are categorized as lead type but are used in the metal casting industry, which also requires alloys of this composition. For example, the excellent antifrictional properties of this alloy make it useful in production of sleeve and journal bearings.[3]

The near-term trend for consumption of lead appears to be downward with a lower limit of approximately 15,000 tons per year by 1980. This lower level is largely based on use of lead type metal in nonprinting industries, and the continued use in 1980 of hot metal by some of the older and larger newspapers and some small plants that may provide hot metal as a courtesy to their customers. Use of hot metal by the printing industry will continue to decline until it is discontinued entirely, probably sometime between 1985 and



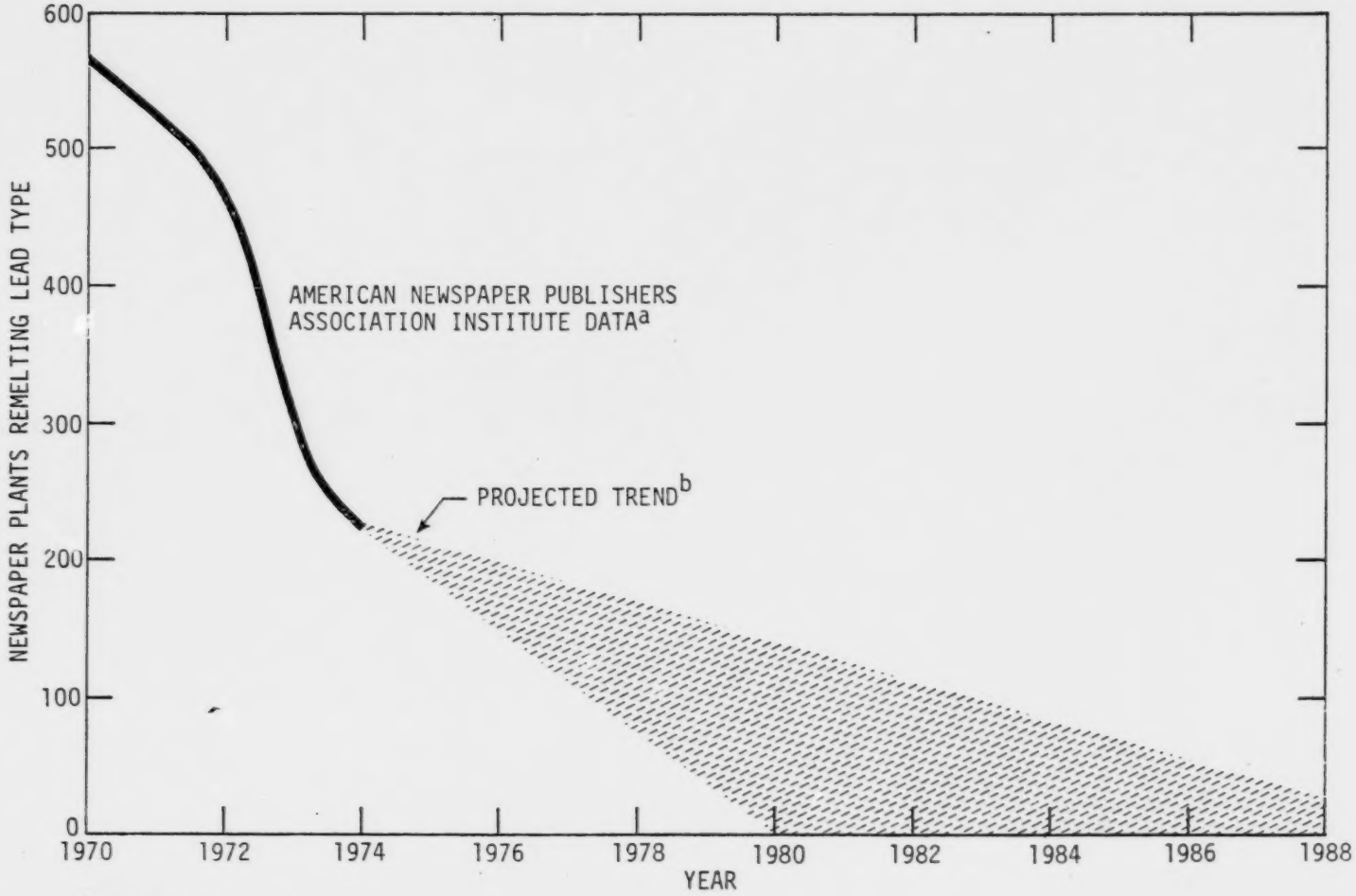
[a]U.S. Bureau of Mines data from 1966 to 1974
1966 - 1967 data, Ref. 4, p. 667
1968 - 1969 data, Ref. 5, p. 638
1970 - 1973 data, Ref. 6, p. 6
1974 data, Ref. 7
1980 projection is based on engineering judgement

[b]PEDCo engineering estimate

Figure 2-1. Consumption of lead as type metal.[a]

1990. One newspaper official speculates that fewer than 10 newspaper hot metal facilities will remain in the U.S. after 5 years.[8]

A better indication of trends in the lead type industry is the number of newspaper plants remelting type metal. This information is solicited from their members each year by the American Newspaper Publishers Association Research Institute.[9] Newspapers and the U.S. Government Printing Office are the major users of the hot metal process. Figure 2-2 shows data from 1970 to 1974, indicating the rapid decline of the hot metal industry.



[a]Ref.10, p. S-19

[b]PEDCo engineering estimate

Figure 2-2. Newspaper plants remelting lead type and projected trend.

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6. Annual Review 1974, op. cit.

7. Personal communication between J.P. Ryan, U.S. Bureau of Mines and F. Hall, PEDCo-Environmental Specialists, August 8, 1975.

8. Trip Report. Report on Presurvey Trip to the Dallas Morning News' Lead Type Facilities. Prepared for the U.S. Environmental Protection Agency by PEDCo-Environmental Specialists, Inc. (Contract No. 68-02-2085). Cincinnati, Ohio. October 8, 1975. 3 pp.

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10. Ibid.

3.0 PROCESS DESCRIPTIONS AND EMISSIONS

This section describes the three principal lead type processes currently used in the printing industry: linotype, monotype, and stereotype.

3.1 THE LINOTYPE PROCESS

The linotype process is an automated method that produces a single line (slug) of lead characters. The lead alloy used by linotypes typically contains 2.5 to 5 percent tin and 10 to 13 percent antimony.

3.1.1 Process Description

The linotype process, as shown in Figure 3-1, melts alloy ingots in a pot and performs all the necessary operations to produce type. These include mold setting, casting, trimming, finishing, and delivering the finished slugs to a tray.

The main melting pot melts spent slugs and make-up virgin metal. This molten metal is poured into molds to produce ingots, which are charged mechanically or manually into individual machine melting pots.

The electrically or gas-heated main melting pot holds several tons of molten metal. The metal working temperature

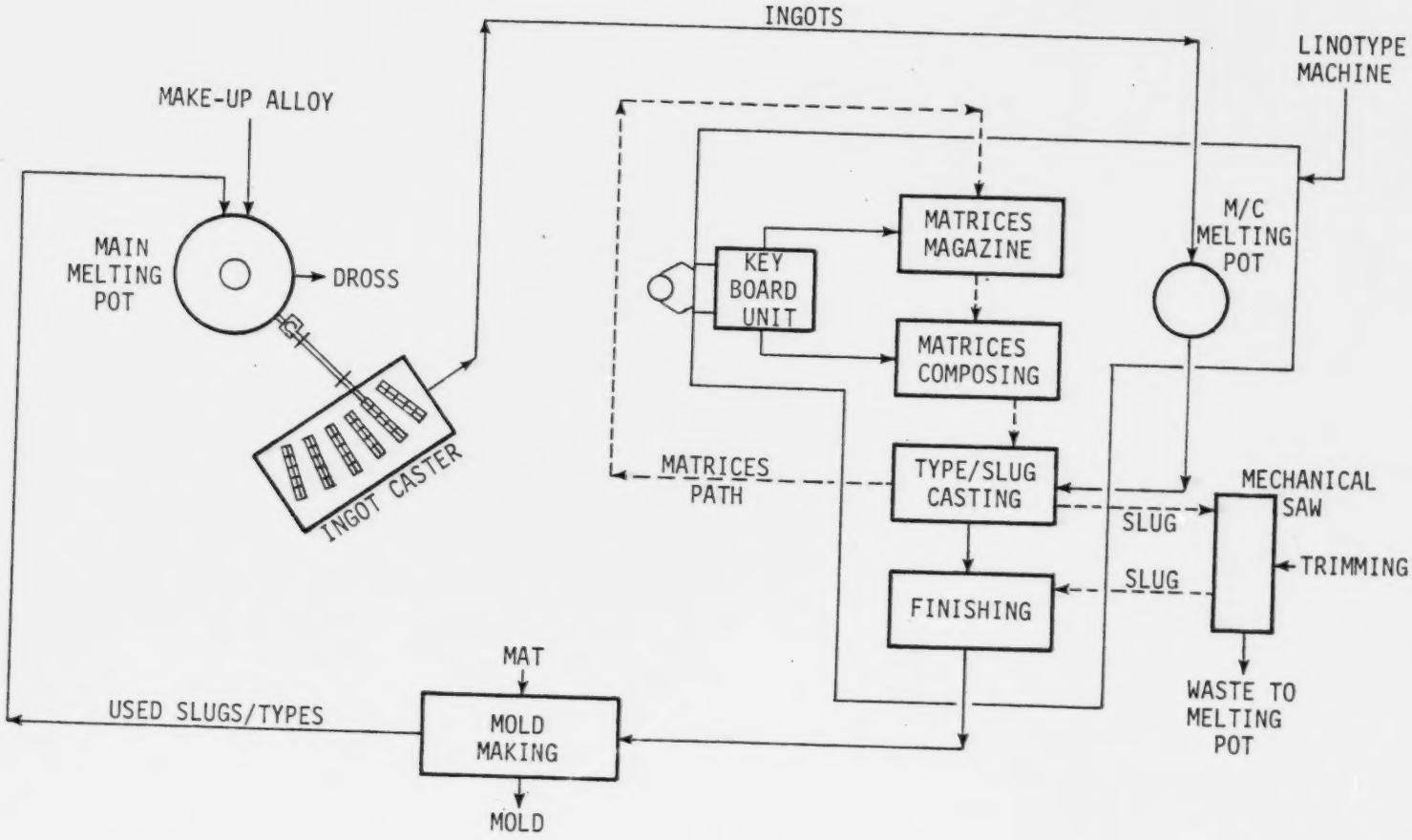

Figure 3-1. The linotype process.

range is normally 550 to 560°F when the pot is gas heated, and 525 to 530°F when it is electrically heated. Figure 3-2 shows an average-size gas-heated melting pot with a bottom pouring valve. In this pot, the flue gases pass over the surface of the molten metal, reducing oxidation and dross. Oxidation is reduced because flue gases contain less oxygen than the atmosphere. Close fitting of the hood and doors and the use of negative pressure prevent fumes from escaping as they pass to the flue or chimney.

The mouthpiece and throat are heated to reduce heat loss and consequent chilling of the metal before it reaches the mold. A relatively higher pot temperature and lower throat temperature give the best casting conditions.

Figure 3-3 shows the ingot molds. For larger outputs, water-cooled molds give good results; for normal work, heavy-duty cast iron molds are satisfactory. Generally, six molds are used in a single casting operation. The molds typically produce ingots weighing 14 pounds, each breaking into ten sections.[1]

Each linotype machine incorporates a small metal pot or well, which can be gas- or electrically heated. The well melts the ingots, which are mechanically or manually charged from the top, and holds the liquid metal until it is needed to mold slugs.

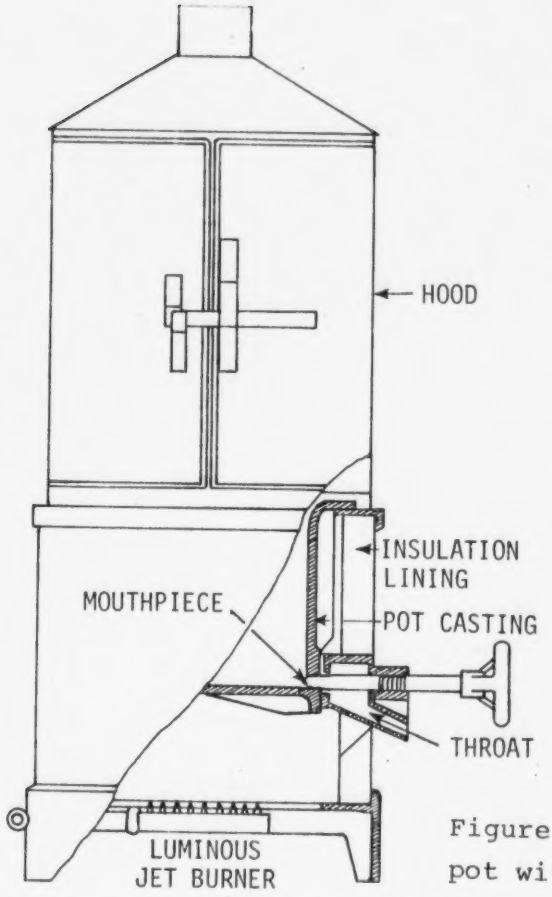

Figure 3-2. Gas heated melting pot with bottom pouring valve.[2]

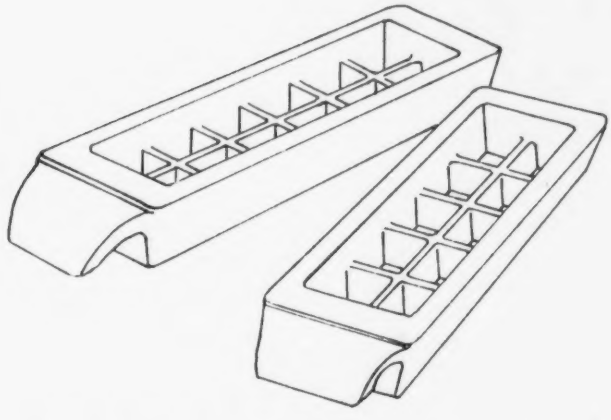

Figure 3-3. Typical ingot molds.[3]

Brass molds or matrices, shown in Figure 3-4, are the basic components in slug production. The casting edge contains the impressions into which the molten metal is forced during the casting operation. Each matrix has a unique combination of teeth, which enables the selector mechanism, activated by pressing appropriate keys, to select the correct matrix (letter). Several of these matrices form a line of type, which is used to cast slugs.

The line of matrices goes to the molding section of the linotype machine, where it is held by a liner attached to the mold disk. A liner is essentially a rack that supports one line of matrices. Four, six, and eight liners are on a mold disk. Figure 3-5 is a sectional view of the molding section of a linotype machine, showing a well, mold disk, liners, and a line of matrices positioned for producing a slug.

When a line of matrices has taken its place in front of the mold disk, the metal pot advances slightly until it touches the back of the mold that is in use. Then the plunger in the center well is lowered, forcing hot lead alloy down into the mold and the indented characters on the matrices. The mold disk rotates while the metal cools and solidifies, becoming a linotype slug as shown in Figure 3-6.

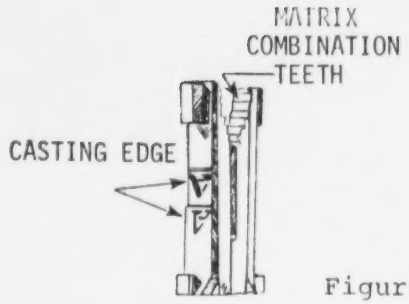

Figure 3-4. Linotype matrix.[4]

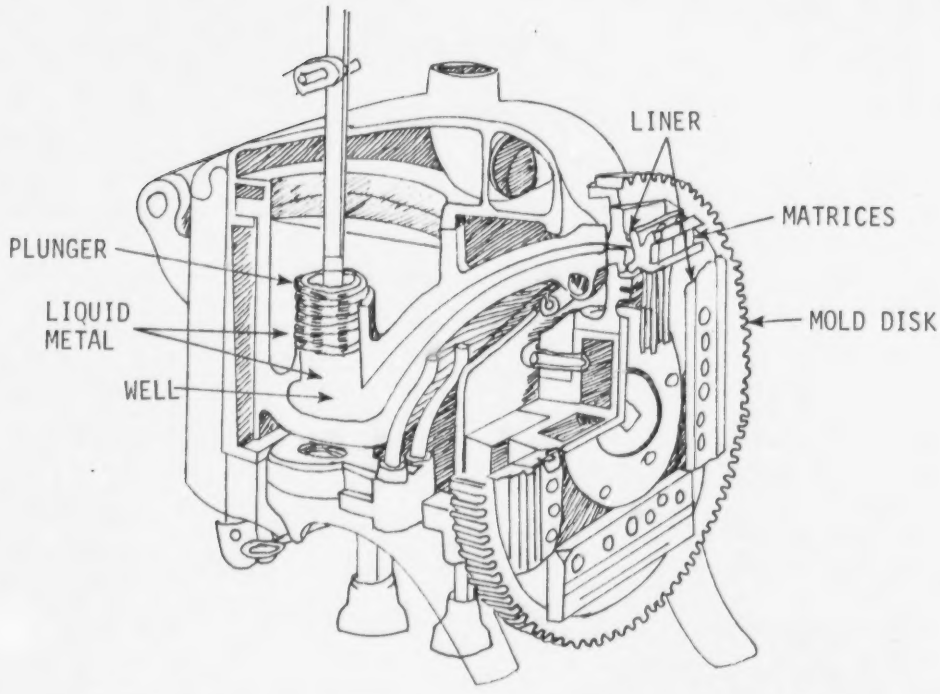

Figure 3-5. Linotype well and mold disk.[5]

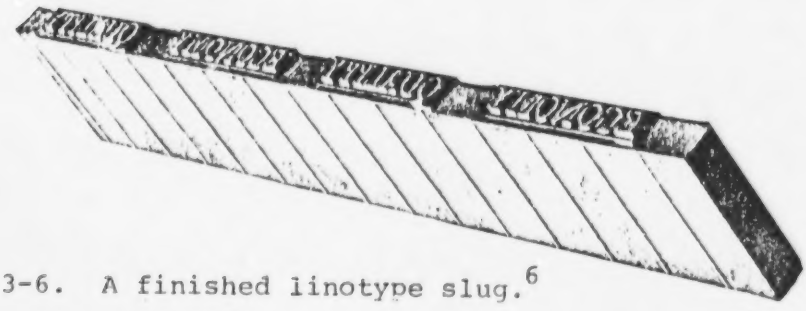

Figure 3-6. A finished linotype slug.[6]

A new set of matrices is then moved into position for molding, and the process is repeated.

Finishing operations are performed on the slug as it is ejected from the mold disk. The disk is rotated until the cast slug is positioned in front of the ejector blades. The ejector blades advance and force the slug to pass through trimming and shaving knives. After finishing operations, the slugs are arranged in a galley, which is a container that stores slugs in the proper sequence.

The line of matrices used for casting is returned to a distributing mechanism (magazine), which locates the proper rack for each matrix by sensing its unique arrangement of teeth.

3.1.2 Emissions

The major point of emissions in linotype operations is the main melting pot. Emissions are mainly particulates, resulting from oxidation of metal in the pot and from oxidation and vaporization of ink and paper impurities in the metal. Emissions are greatest during addition of used metal and drossing when the melted metal is agitated. Combustion products from the heating equipment are insignificant, since this equipment is electrically heated or gas-fired. Transfer of liquid metal to molds for ingot casting produces emissions from oxidation of hot metal. Lead emissions due to evaporation are believed to be small because of the low

vapor pressure at melting temperature (less than 10^{-5} mm Hg at 622°F).[7]

The individual machine melting pot has little exposed surface and is used only for melting comparatively pure metal; emissions at this point are insignificant.

The slug finishing operations emit fine metal particles, which are emitted into the work area and settle out before being vented to the atmosphere, since they are relatively heavy.

The U. S. Government Printing Office has done lead sampling in the linotype area of their hot metal operations. Linotype machines at the U.S. Government Printing Office are uncontrolled and are not vented to the outside. Average measured lead concentrations were less than 0.034 mg/m^3 in the linotype machine area and less than 0.064 mg/m^3 in the linotype melting pot area.[8] All reported values are lower than the proposed OSHA standard of 0.1 mg lead/m^3 of air for an 8-hour exposure limit.[9]

3.2 MONOTYPE PROCESS

As the name indicates, the monotype process casts single letters or symbols. This type can be in complete lines when used in machine composition or individual letters to be placed in cases for hand composition.

3.2.1 Process Description

The monotype machine is more flexible than other

machines with regard to input metals. Several distinct grades of metal give satisfactory results. For example, regular linotype slug metal can be used safely with monotype machines and often is used where both type of machines are installed. One monotype company recommends a blend of 9 percent tin, 19 percent antimony, and 72 percent lead.[10] This blend is harder than other mixtures, but requires more heat and shows greater wear on casting parts. It is used to achieve hardness and perfection of face.

Another grade of metal sold for monotype machines is "job type" metal, characterized by its hardness. It is sometimes called display type or foundry type metal. Display type typically contains 70 percent lead, 20 percent antimony, and 10 percent tin; the harder foundry type contains approximately 62 percent lead, 24 percent antimony, and 14 percent tin. The foundry type alloy is used for high-grade printing or for operations requiring repeated use of the type.[11]

The ingot casting operation in the monotype process is the same as in the linotype process, as shown in Figure 3-1. The major difference in the two processes is in the machine mechanisms for selecting molds and casting the types. A monotype typesetting machine consists of two units, a keyboard and a typecasting machine. The keyboard (resembling a large typewriter) punches holes in a paper ribbon, which

the typecasting machine then uses to select the appropriate matrices. The matrices are contained in a monotype matrix case at the typecasting machine. When the keyboard operator depresses a key, compressed air activates the two punches representing the character (letter or number) desired. These punches perforate the paper ribbon, which is approximately 4 inches wide. Each pair of holes in the ribbon represents an intersection of one horizontal and one vertical row in the matrix case. Figure 3-7 shows a monotype matrix case, and Figure 3-8 shows the two types of monotype

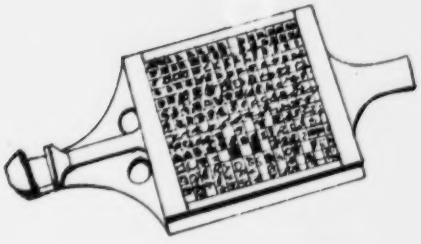

Figure 3-7. Monotype matrix case.[12]

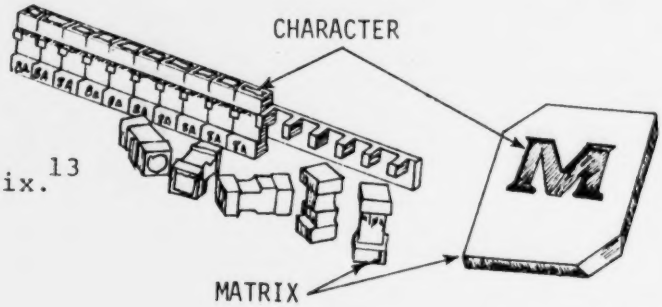

Figure 3-8. Monotype matrix.[13]

matrices.

The action of the ribbon on the casting machine is similar to that of a roll on a player-piano. The ribbon travels over a cylinder having rows of holes corresponding to all the keyboard punches while a steady flow of compressed air is applied to the top surface of the ribbon.[14] The air passing through the holes in the paper is directed to corresponding steel pins. All pins are arranged in two groups on the top of the machine. The air raises the two pins (one in each group) corresponding to the desired matrix. Each raised pin is grasped by a pair of jaws, which open and close with each pair of holes exposed on the ribbon. The jaws then position the character selected by the keyboard over the mold and lower it onto the mold. The matrix is then held firmly in place by a heavy steel pin, which fits a cone-shaped hole in the back of each matrix.

When the character is positioned over the mold and the width for that character is provided in the mold, the molten metal is injected. The character is thus formed with the aperture in the mold providing the depth, width, and height (the body) of the type, and the matrix its face. Water flowing through the mold, but not in contact with the metal, cools and solidifies the character. After the character is cast and the matrix case lifts, the character is ejected from the mold into the carrier, which draws it back

to the point where it is assembled into the line. When the end of a line is reached, the complete line is drawn out and transferred to a galley (storage container) until the work or a desired section of it is finished. Figure 3-9 shows the monotype caster.

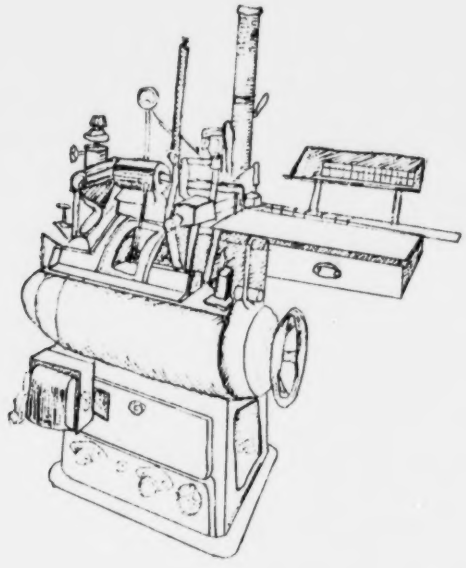

Figure 3-9. Monotype caster.[15]

3.2.2 Emissions

Emissions from the monotype process are similar to those from the linotype process. The recycled "dirty" type containing printing ink, paper, and other impurities causes smoke. The emissions created after meltdown by oxidation of lead in the pot are small, the major portion occuring during addition of used metal or drossing. At these times the melted metal is agitated and the emissions increase.

Since the main melting pot is electrically or gas-heated, emissions from heating equipment alone are insignificant.

Source test data are very limited since monotype exhausts generally are not controlled or vented. The U.S. Government Printing Office conducted air sampling periodically during 1974 and 1975 to determine the levels of lead to which employees were exposed. Samples of air near the casting machines at the employee's breathing zone revealed lead concentrations of less than 0.035 mg/m^3. Average lead concentrations in the monotype casting room were less than 0.020 mg/m^3. These concentrations are much lower than the proposed OSHA standard of 0.1 mg lead/m^3 of air for an 8-hour exposure limit.[16]

3.3 STEREOTYPE PROCESS

In the stereotype process a number of identical printing plates are produced from the same mold known as a mat. The mat is produced by some other method such as the linotype process and/or photoengraving.

Stereotype alloy represents a very large part of all type-metal alloys in use; typically it contains 6 to 8 percent tin, 13 to 15 percent antimony, and 78 to 82 percent lead. It is one of the most sensitive of all type metals, and its purity and composition are of prime importance. Stereotyping differs from other typecasting processes mainly

in three ways: (1) size of the casting, (2) flow of metal, and (3) use of a nonmetallic surface against which the metal is molded.[17] Stereotype metals therefore must have good casting qualities and must produce a good reproduction of the mat printing face mold. Troubles inherent in the metal can be greatly magnified because the plate is large and cooling is slow and uneven. These troubles may show up as (a) sinks (indentations in the face of the metal as cast); (b) hot streaks (frosty spots); (c) cold halftones (dots not filled out and lost for printing); (d) porous plates (honeycomb structure); and (e) disintegrated type.

Many stereotype plates are plated electrolytically with either nickel or iron to increase their resistance to wear. When nickelplated plates are remelted, small pieces of nickel contaminate the dross and reduce its value because of the smelting problems that the nickel causes in type-metal manufacture. Iron-plated stereotype plates are hard to store without rusting of the iron. Also, the iron plating bath is more sensitive than the nickle bath and requires greater care to adjust for proper plating.[18]

3.3.1 Process Description

As shown in Figure 3-10, the stereotype process involves production of a mold or mat into which the hot metal is cast. Two types of mats are produced, wet and dry. Wet

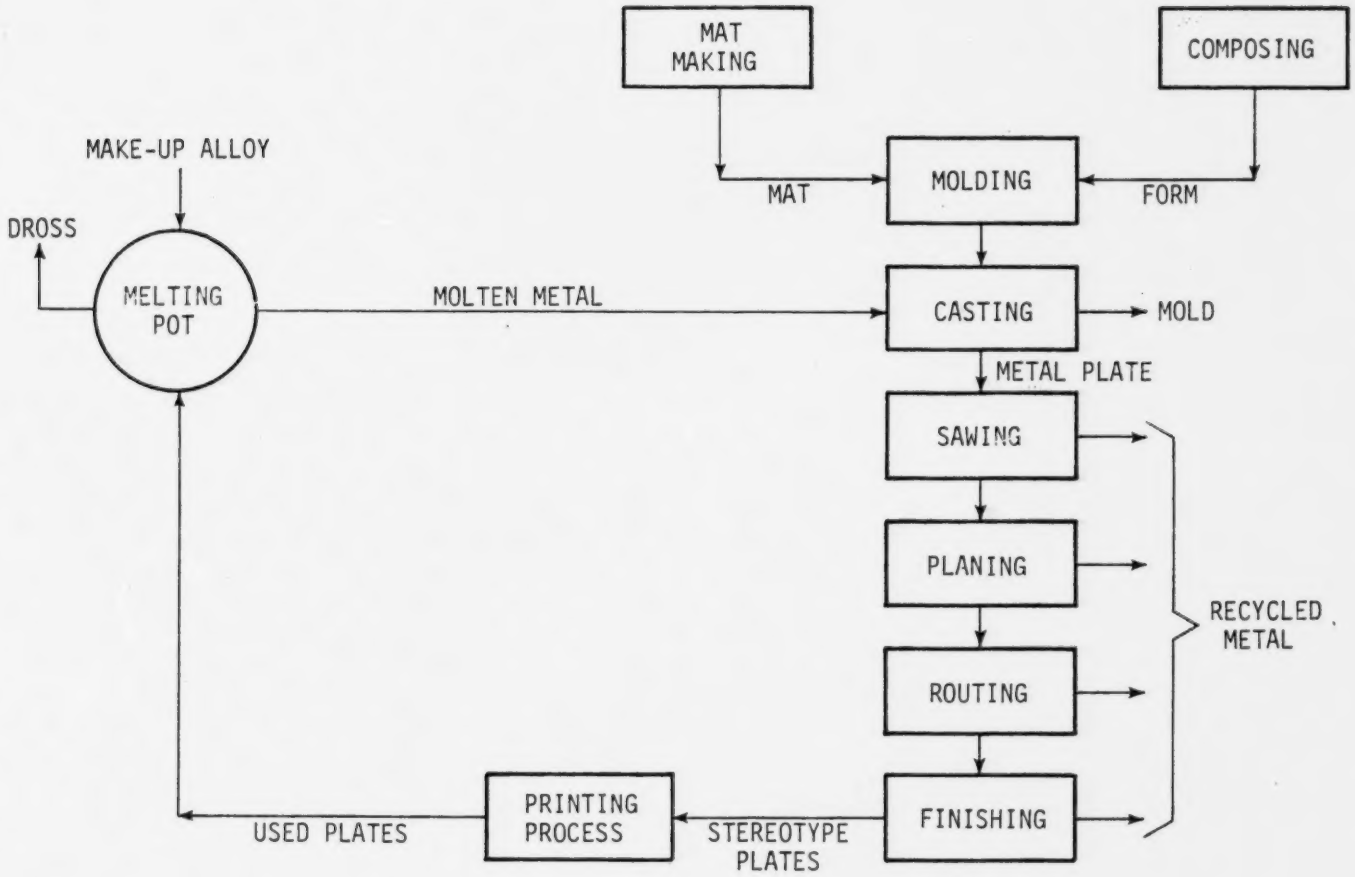

Figure 3-10. The stereotype process.

mat, usually prepared in the foundry, is composed of alternate layers of tissue and blotting papers joined with a special paste. The final mat has a blotting base and a tissue face.

The mat is prepared on a flat metal table or other hard, flat surface. As each sheet of tissue or blotting paper is pasted down, a heavy cast-iron roller is rolled back and forth across the surface to completely amalgamate the paper surfaces and to disperse any air bubbles or irregularities.[19]

The mat thus prepared is laid tissue side down, on the prepared form and beaten with a stiff-bristled beating brush. This beating eliminates air pockets and ensures good halftone reproduction. The form, covered with the mat and additional thicknesses of blotting paper (called the dripping blanket), is then placed in a hot press under pressure and thoroughly dried. The dripping blanket absorbs dampness from the mat, which dries rapidly. This wet molding process requires much more time than the dry molding process.[20]

Dry mats are of two types, completely dry and damp. The former is molded in a completely dry state and pressed in a hydraulic press. The damp molding process uses humidified mat sheets for molding. Damp mats are stored in humidifiers to prevent drying.

The mold is next prepared for casting by packing. The hollows in the back, which correspond to whites on the face (areas not used for printing) are filled by pasting in strips of thin cardboard or similar substance. This process, called packing, eliminates a considerable amount of finishing work on the stereotype plate and reduces the amount of metal to be removed by the routing machine.

After the mold is packed, a strip of paper is attached. The paper is long enough to reach from the top position the mold will occupy in the stereotype casting box to the pouring lip (where the lead alloy is poured into the box). Its purpose is to act as a guide for the metal as it is poured into the stereotype casting box and to aid in removal of the mold from the cast. Figure 3-11 shows the stereotype casting box in the open position ready for closing; Figure 3-12 shows the stereotype casting box in closed position and metal being poured.

The mold is placed face up on the flat surface of the casting box. Gauges (see Figure 3-11) hold the mold in place. When everything is set, the stereotype casting box is closed and the metal is poured, either manually or automatically. The metal is melted and maintained at approximately 570°F. A large electrically heated or gas-fired pot is used to melt the alloy.

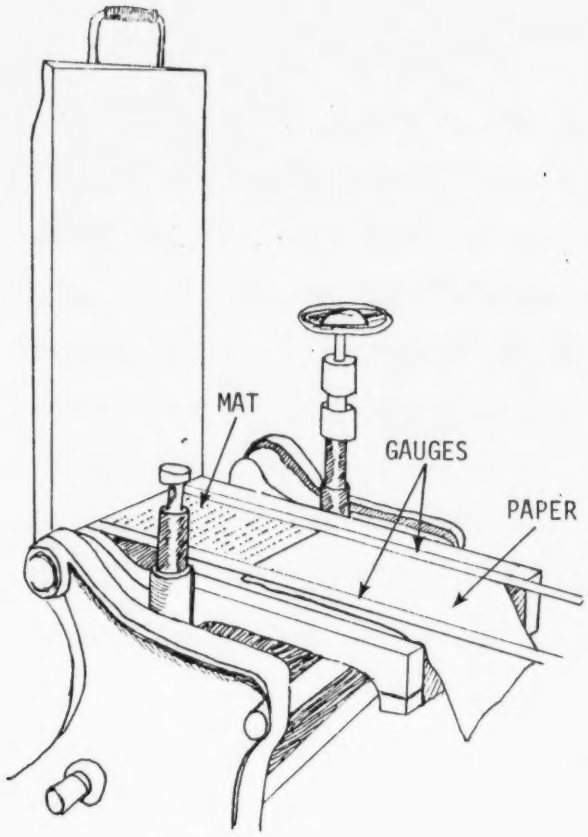

Figure 3-11. Stereotype casting box in open position.[21]

(The Hamlyn Group Picture Library)

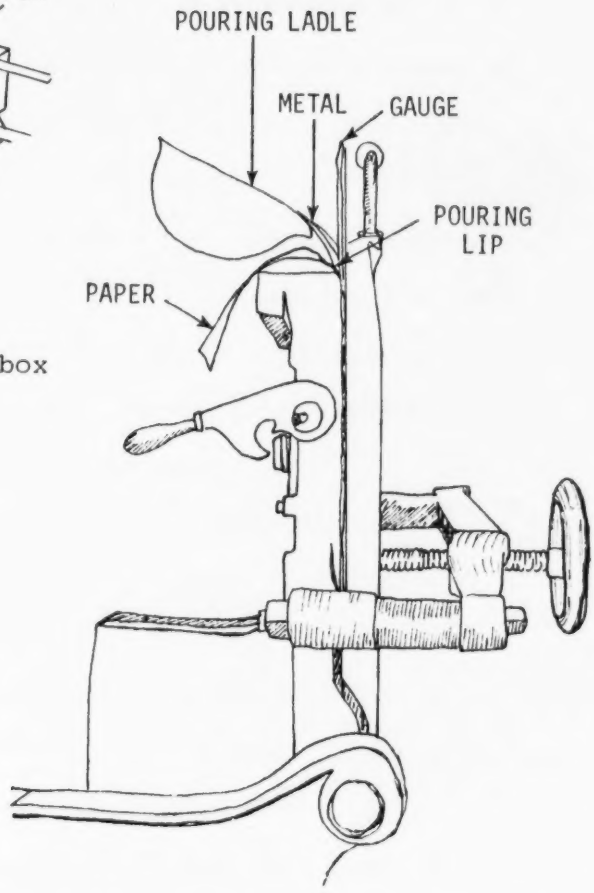

Figure 3-12. Pouring metal into the stereotype casting box.[22]

(The Hamlyn Group Picture Library)

The mold is placed in the casting box as far from the pouring edge as possible to provide a long tang (the poured metal that extends from the top of the mold to the pouring edge). The purpose of the tang is to force the metal beneath it into the detail of the mold. Because of its greater volume the tang does not solidify as quickly as the metal in contact with the mold. It therefore provides a reservoir of fluid metal from which the cast is fed as it cools. In its fluid state the tang also provides a means of escape for the air displaced from the box during pour, and prevents the air from becoming trapped in the plate.[23]

After the solid plate is removed from the stereotype, the mold is carefully separated and can be reused. The tang is sawed off to within half an inch, and the casting is then passed to the finishing department, where it is shaped to the required thickness by a planing machine.

The casting is further examined, and superfluous metal is removed on a routing machine. Large solid areas may require burnishing or bringing up from the back (applying pressure to the backside of a plate to raise the face of a plate); intersecting lines or breaks in straight lines may need joining. Other minor finishing may be required.

Rotary stereotyping for commercial purposes generally follows the same techniques. Present-day packaging calls

for large-volume production of cartons, newspapers, packages, and end and side labels. Since the sizes and designs are relatively constant for a particular product and the demand is continuous, packaging materials are particularly suitable for production by rotary printing machines.[24]

Only one original block need be made for repetition of the same design or label on one rotary plate. Several flat stereos can be prepared from the single original block. By proper spacing of these plates, a mold can be produced that is used to create a cylindrical plate for rotary stereotyping.

3.3.2 Emissions

The melting pot is the major source of emissions. Melting the "dirty" metal plates containing printing ink, paper, and other impurities causes smoke, which contains hydrocarbons as well as particulates. Only small quantities of particulates are created after meltdown by the oxidation of lead because of the protective layer of dross on the metal surface.

Transfering and pouring of molten metal at high temperature into the molds involves surface oxidation of the metal and may also produce oxidized fumes.

The finishing and machining operations emit lead particles. These emissions are insignificant because the

particles are large and tend to settle out in the vicinity of the finishing machines.

Only limited source testing has been done on stereotype metal melting pots. Source tests conducted at two uncontrolled newspaper facilities indicate that about 37 percent of the total particulate emissions from melting pots is lead. One plant with a total melting pot volume of 65 tons emitted 1.86 pounds per hour of total particulate, of which 0.739 pound per hour was lead.[25] Another plant with a 95-ton melting capacity emitted 2.2 pounds per hour of total particulate (0.757 pound per hour of lead) with all pots in operation.[26] Because the air flow rates at these plants vary widely (24,000 scfm and 2700 scfm), grain loading data alone are not meaningful. One vendor estimates that in ventilation air volumes are about 150 acfm per square foot of melting pot surface area and that emissions average 3430 mg/m^3 (1.5 gr/scf) during addition of used metal and 914 mg/m^3 (0.4 gr/scf) during drossing.[27] These emission rates are peaks; average emissions are much lower.

The U.S. Government Printing Office tested lead concentrations in the plant atmosphere while stereotype metal was being poured into a mold. Lead concentrations averaged less than 0.068 mg/m^3 at the breathing level. This is below the proposed OSHA limit of 0.1 mg lead/m^3 of air for an 8-hour average concentration.[28]

3.4 REFERENCES FOR SECTION 3

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22. Ibid.

23. Ibid.

24. Ibid.

25. Source Test. San Francisco Newspaper Printing Co., San Francisco, April 13-14, 1975.

26. Source Test. Detroit News. Wayne County Department of Health Air Pollution Control Division, Detroit, 1970.

27. Newspaper Lead Pot Melting. Item No. 4055, Data Sheet DC-608. AAF Sales Book. American Air Filter. February 1, 1968. 3 pp.

28. Federal Register, op. cit.

4.0 EMISSION REDUCTION TECHNIQUES

The most frequently controlled sources at hot metal printing facilities are the main melting pots and drossing areas. During drossing, hood doors are opened and pot emissions enter the plant atmosphere unless vented to a control device or to the outside. Linotype melting pots and routers do not require emission controls when they are operated properly. Emission control devices in current use are Roto-clones, wet scrubbers, filters, and electrostatic precipitators; these can be used in various combinations.

Control devices were originally installed to trap hydrocarbons and prevent fires in the exhaust system ducts. Roto-clones were usually sufficient for this purpose. Recently (within the last 5 years) there has been concern with the visible emissions from newspaper plant stacks (primarily caused by hydrocarbons). Some plants added controls to eliminate these visible emissions. While removing hydrocarbons, these control systems also no doubt remove some of the heavier particulates that contain lead.

4.1 ROTO-CLONES®

Roto-clones are the most widely used devices for control of hot metal operations. They offer the advantage of acting both as an exhaust fan and a control device.

Basically, a Roto-clone is a centrifugal fan with a water spray at the inlet and a sludge chute for removal of "dirty" water at the outlet, as shown in Figure 4-1. The rotating impeller is sprayed with water so that the particulates in the incoming air will impinge on and be trapped by the water film on the blades. The resultant slurry is then drained, while the air exhausts through the stack. The estimated efficiency of particulate removal for Roto-clones in lead pot melting applications is 75 to 85 percent.[1] Water requirements are typically 0.5 to 1 gallon per 1000 acfm of air cleaned.[2] The water is normally drained to a settling chamber and is not recycled.

The Roto-clone apparently has solved the problem of fires in the exhaust system. Additional controls are needed, however, at plants in locations where opacity limitations are stringent. Although no source test data are available to indicate the efficiency of Roto-clones in removing particulates containing lead, the device probably collects most of the lead emissions because of their high

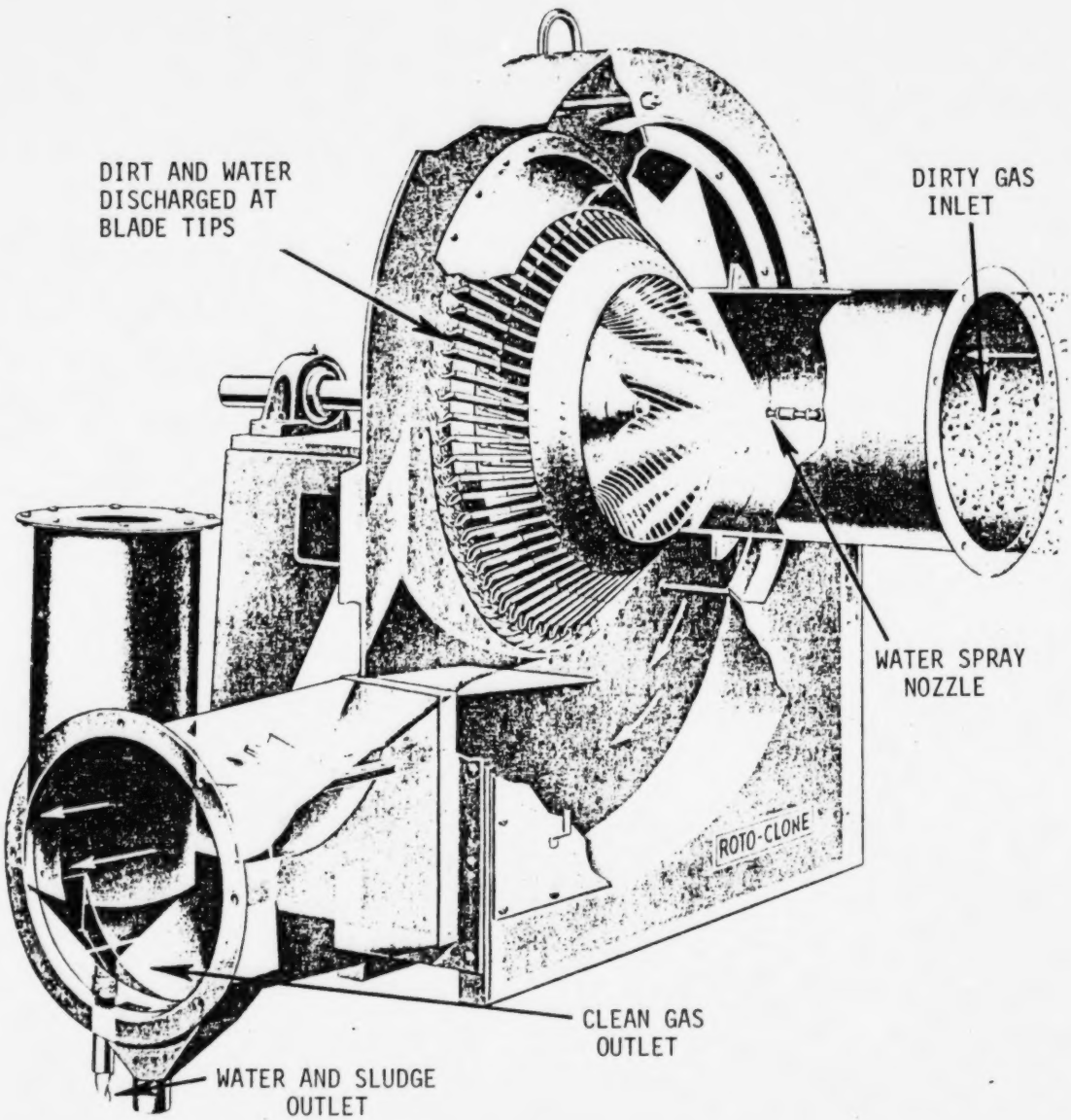

Figure 4-1. Roto-clone (American Air Filter Co., Inc. Louisville, Ky.).

specific gravity.* Collection efficiency could be determined only by measuring lead concentrations at the inlet and the outlet of Roto-clone controlled operations.

The installed cost of a Roto-clone for control of a typical lead pot requiring 3000 acfm would be 12,000 to $14,000 (Table 4-1). This includes cost of equipment and installation of the Roto-clone, tight-fitting hood, ductwork, and piping. It does not include any required water treatment facilities. Scrubbing systems typically use recirculated water and the sludge is periodically tapped off and sent to secondary metal reclaiming operations. Annual operating costs would be approximately $6,100/yr (Table 4-2). This estimate is based on continuous operation and a

Table 4-1. CAPITAL INVESTMENT - ROTO-CLONE[a]

(dollars)

Direct costs		
Roto-Clone and auxiliaries		8,100
Indirect costs		2,700
Contingency	20% of direct and indirect costs	2,200
	Grand Total	13,000

[a] Based on cost information supplied by American Air Filter, and the Kansas City Star.

* PEDCo engineering judgment.

Table 4-2. ROTO-CLONE ANNUAL OPERATING COSTS[a]

(dollars)

	Quantity	Unit cost	Annual cost, $
Utilities			
Electricity	4 kW	30 mills/kWh	1,050
Water	180 gal./hr	$0.20/1000 gal.	315
Operating labor			
Direct labor	1 hr/wk	10.00/hr	520
Supervision	15% of direct labor		80
Maintenance			
Labor and materials	5% of fixed investment		650
Supplies	15% of labor and materials		100
Overhead			
Plant	50% of operation and maintenance		680
Payroll	20% of operating labor		120
Fixed cost			
Depreciation ($\frac{1}{\text{Avg. plant life}}$) (100%) = 10%			
Interim replacement (0.35%)			
Insurance (0.3%), Taxes (0%)[b]			
Capital cost (9%)			
Total fixed charges (19.65%)			2,550
		Total Cost	6,100

[a] Reference 8. Section 26.

[b] Control equipment is normally tax exempt.

10-year equipment life; it includes an annual fixed cost of $2,550/yr. Operating costs include an interim replacement cost of 0.35 percent of the capital investment. Interim replacement costs are those incurred due to unexpected equipment failures which are not considered part of routine maintenance.

4.2 ELECTROSTATIC PRECIPITATORS

Low-voltage electrostatic precipitators (ESP's) are used to control visible emissions from hot metal melting pots, both as a primary control device and as a secondary control device in series with a Roto-clone or fabric filter.

ESP's operate on the principle of charging the particles with a high-voltage field and collecting them on plates of opposite polarity. The collected dust is removed from the plates by rapping or washing. Plates from the ESP's installed to control exhausts from hot metal facilities are usually cleaned by washing with soap and water, either manually or automatically. Reportedly, many problems with ESP units that require manual cleaning are caused by damage of plates during removal from the unit and during washing.

Off-the-shelf ESP units are available to control 3000 to 20,000 acfm of exhaust fumes. A typical melting pot for lead plates requires a control device that can handle 150

acfm per square foot of surface area and withstand temperatures of about 200°F.[3] Normally a low-voltage ESP (10-15 kV) is used, and an overall particulate removal efficiency of 85 to 95 percent is expected.

Installed costs for an ESP to control 3000 acfm would range from 18,000 to $22,000 (Table 4-3). Control is improved when a Roto-clone is installed ahead of the ESP to cool the exhaust and condense the hydrocarbons. The Roto-clone also acts as a fan for the system. A Roto-clone/ESP control system could be installed to control 3000 acfm at a cost of about $34,000. Annual operating costs for an ESP alone are estimated to be approximately $10,100/yr. This estimate is based on continuous operation, 10-year equipment life, and a 2 gal./day detergent usage at $3.30/gal. It includes an annual fixed charge of $3,900 (Table 4-4).

Table 4-3. CAPITAL INVESTMENT - ELECTROSTATIC PRECIPITATOR[a]

(dollars)

Direct costs		12,500
Indirect costs		4,200
Contingency	20% of direct and indirect costs	3,300
	Grand Total	20,000

[a] Based on cost information supplied by American Air Filter and the Kansas City Star.

Table 4-4. ELECTROSTATIC PRECIPITATOR ANNUAL OPERATING COSTS[a]

(dollars)

	Quantity	Unit cost	Annual cost, $
Utilities			
Electricity	4 kW	30 mills/kWh	1,050
Water	40 gal./day	$0.20/M gal.	3
Cleaning materials			
Soap	2 gal./day	$3.30/gal.	2,409
Operating labor			
Direct labor	1 hr/wk	$10.00/hr	520
Supervision	15% of direct		80
Maintenance			
Labor and materials	5% of fixed investment		1000
Supplies	15% of labor and materials		150
Overhead			
Plant	50% of operation and maintenance		880
Payroll	20% of operating labor		120
Fixed cost			
Depreciation ($\frac{1}{\text{avg. plant life}}$) (100%) = 10%			
Interim replacement (0.35%)			
Insurance (0.3%), Taxes (0%)[b]			
Capital cost (9%)			
Total fixed charges (19.65%)			3,900
		Total Cost	10,100

[a] Reference 8. Section 26.

[b] Control equipment is normally tax exempt.

4.3 FILTER CONTROL SYSTEMS

Filters are also used for control of emissions from hot metal operations, both alone and in series with other control devices (normally a Roto-clone). Typical filters are metal or fiber glass panels of varying mesh, fiber glass bag filters, and roll-type fabric filters. Because of the small exhaust volumes (typically less than 10,000 acfm) and the fluid nature of hydrocarbon emissions from hot metal operations, it is impractical to install large baghouses with automatic cleaning systems. Instead, the filters used in these operations are disposable; they are removed when necessary and replaced with new filters.

Metal of fiber glass panel filters, as shown in Figure 4-2, are used when the exhaust grain loading is expected to be low, as it usually is with slave pots or holding pots that receive melted metal from a central remelt pot. When the liquid metal gets to these pots, the hydrocarbons and newsprint impurities have been driven out. The emissions are mainly metal oxides, which are present in much smaller quantities and are easier to collect than hydrocarbons.

Roll-type filters, as shown in Figure 4-3, are used at one newspaper operation to control lead pot emissions. This system uses a fiber glass or paper filter on rollers that move the filter across the flow path of the gas. As the

Figure 4-2. Panel filter (American Air Filter, Louisville, Ky.)

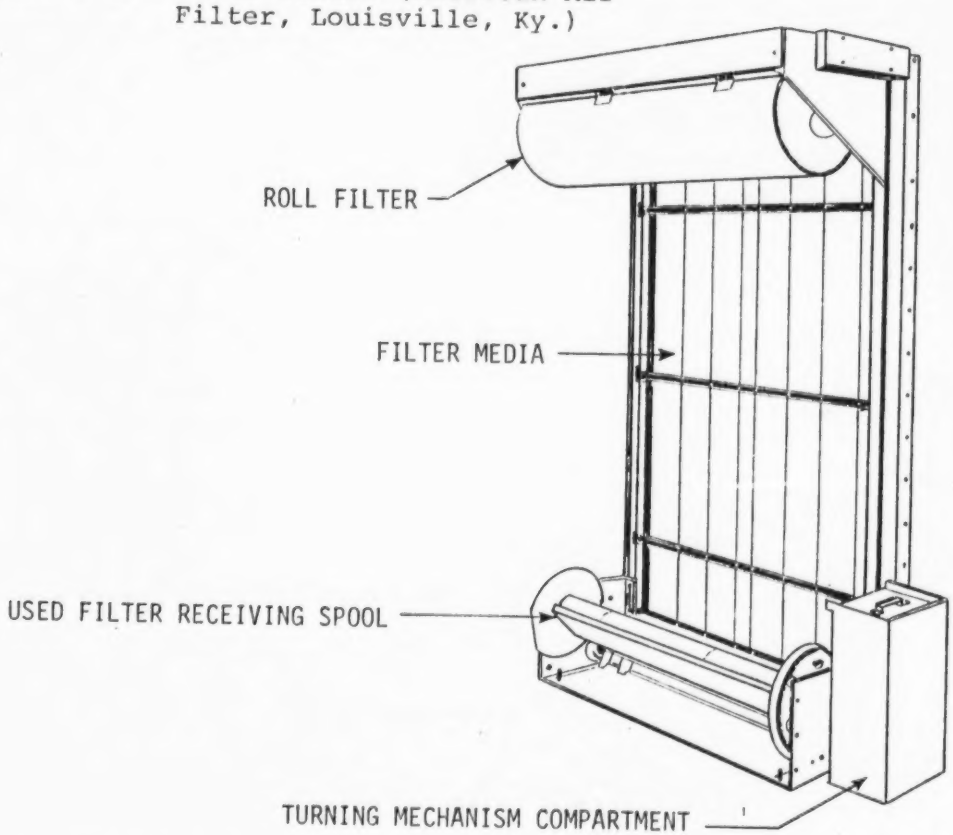

Figure 4-3. Roll type filter (American Air Filter, Louisville, Ky.).

filter collects particulate, the pressure drop across it increases. When the pressure drop reaches a predetermined value the filter is manually or automatically rolled until a clean filter surface is exposed. After the roll of filtering material has been used, it is removed and a clean filter roll installed. Particulate removal efficiency is usually greater than 95 percent with pressure drops of 5 to 10 inches, water gauge.

Installed costs for filter systems vary widely, depending upon the type installed and the control requirements of the pot. Pots used to melt stereo plates from the presses require hydrocarbon controls and cooling of the exhaust before filtration. Holding pots, on the other hand, may require only panel filters to remove the lead oxide particulates. Therefore, installed costs for filter systems to control 3000 acfm could range from less than $1,000 for a panel filter system up to $30,000 for a roll-type filter system that includes automatic controls and additional fans. For a $15,000 baghouse system (Table 4-5) operating continuously with a 10-year equipment life, annual operating costs would be approximately $7,500/yr (Table 4-6).

Table 4-5. CAPITAL INVESTMENT - BAGHOUSE[a]

(dollars)

Direct costs		
Baghouse and auxiliaries		9,350
Indirect costs		3,160
Contingency	20% of direct and indirect costs	2,500
	Grand Total	15,000

[a] Based on information from American Air Filter.

4.4 WET SCRUBBERS

Venturi scrubbers and other high pressure spray control devices have been used to control emissions from hot metal operations. The high-pressure sprays used in the newspaper industry consist of a water curtain through which the exhaust gases are drawn. The resultant sludge is normally sent to a secondary metal reclaiming operation or trucked to a sanitary landfill in containers. The water, after settling and pH adjustment, is recirculated through the scrubber or at one plant, the water is drained to a sewer.

Reportedly, a venturi scrubber with a pressure drop of 20 inches water gauge can remove 95 percent of the total particulates.[4] Water requirement for this efficiency is estimated to be 8 gallons per 1000 acfm of exhaust to be cleaned.[5] No test data are available to indicate the re-

Table 4-6. BAGHOUSE - ANNUAL OPERATING COSTS[a]

(dollars)

	Quantity	Unit cost	Annual cost, $
Utilities			
Electricity	6 kW	30 mills/kWh	1,600
Filters	$50/mo		600
Operating labor			
Direct labor	1 hr/wk	$10.00/hr	520
Supervision	15% of direct labor		80
Maintenance			
Labor and materials	5% of fixed investment		750
Supplies	15% of labor and materials		110
Overhead			
Plant	50% of operation and maintenance		730
Payroll	20% of operating labor		120
Fixed Cost			
Depreciation	$\left(\frac{1}{\text{avg. plant life}}\right)$ (100%) = 10%		
Interim replacement (0.35%)			
Insurance (0.3%), Taxes (0%)[b]			
Capital cost (9%)			
Total fixed charges (19.65%)			2,950
		Total Cost	7,500

[a] Reference 8. Section 26.

[b] Control equipment is normally tax exempt.

moval efficiency of particulates containing lead. Officials at one facility using a venturi scrubber as a control device estimate that the inlet loading to the scrubber is 0.5 grain per scf and the outlet contains 0.025 grain per scf of particulate.[6]

High-pressure sprays are also used to control visible emissions from hot metal operations. Removal efficiency for total particulates from the melting pots is estimated to be 80 to 90 percent.* A high-pressure spray installed at one plant in 1950 for fire prevention appears to prevent visible emissions. The differential pressure and air flow are unknown; a 40-horsepower fan is required to ventilate the exhaust.

The installed cost of a venturi scrubber system to control 3000 acfm would be 27,000 to $30,000 (Table 4-7). This would include all equipment and installation of the fan, ductwork, and plumbing. The estimate is based on a scrubber with a pressure drop of 20 inches water gauge and with a 24-gpm water requirement. It does not include water treatment facilities since the water can be recirculated and the sludge can be sent to a secondary metal reclaiming operation. Annual operating costs for a scrubber with a 20-inch pressure drop and 10-year equipment life would be approxi-

mately $20,800/yr, excluding water treatment costs. This cost includes annualized fixed charges of $5,600/yr (Table 4-8).

Table 4-7. CAPITAL INVESTMENT - VENTURI SCRUBBER[a]

(dollars)

Direct costs		
Venturi scrubber and auxiliaries		17,800
Indirect costs		6,000
Contingency	20% of direct and indirect costs	4,750
	Grand Total	28,500

[a] Based on cost information supplied by American Air Filter.

4.5 OTHER METHODS OF CONTROL

In the past, various control methods were used to prevent visible emissions or to prevent fires. These techniques generally were directed to control of hydrocarbons or newspaper wastes adhering to the used metal plates. Therefore, the control methods did not always decrease the emissions of lead oxides in the exhaust stream.

At one hot metal operation an attempt was made to wash the used plates with soap and water before remelting them. This proved to be both time-consuming and ineffective, since

Table 4-8. VENTURI SCRUBBER ANNUAL OPERATING COSTS[a]

(dollars)

	Quantity	Unit cost	Annual cost, $
Utilities			
Electricity	12 kW	30 mills/kWh	3,150
Water	1440 gal/h	0.20/M gal.	2,520
Operating labor			
Direct labor	1 hr/day	$10.00/hr	3,650
Supervision	15% of direct labor		550
Maintenance			
Labor and materials	5% of fixed investment		1,420
Supplies	15% of labor and materials		210
Overhead			
Plant	50% of operation and maintenance		2,900
Payroll	20% of operating labor		840
Fixed cost			
Depreciation ($\frac{1}{\text{avg. plant life}}$) (100%) = 10%			
Interim replacement (0.35%)			
Insurance (0.3%), Taxes (0%)[b]			
Capital cost (9%)			
Total fixed charges (19.65%)			5,600
		Total cost	20,800

[a] Reference 7. Section 26.

[b] Control equipment is normally tax exempt.

not all of the ink and impurities could be removed from the plates by washing. Moreover, this technique did nothing to minimize lead emissions. Costs for such a cleaning operation would be approximately $2.00 per plate cleaned.* This would include manpower and washing equipment.

Apparently some plants having long lengths of horizontal ductwork have no problem of visible emissions. The ducting acts as a large settling chamber and the heavier particles settle out. The long duct also allows cooling of the hydrocarbons and settling out of some condensibles. One control equipment vendor states that horizontal ductwork usually acquires a heavy bottom layer of solids when used for exhausting lead pots.[8] Two tests indicated that particulates exhausting to the atmosphere through a relatively short duct contained 34 to 39 percent lead;[9,10] while one test revealed that total particulates at the exit of ductwork containing long horizontal sections contained approximately 5 percent lead.[11] One explanation could be that more of the heavy particulates containing lead settle in the ductwork than do the lighter particles, so that a smaller fraction of lead is found in the particulate catch. (The test at the facility showing low lead concentrations was not isokinetic).

4.6 REFERENCES FOR SECTION 4

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5.0 PLANTS WITH EFFECTIVE SYSTEMS OF EMISSION REDUCTION

The most effective emission control systems consist of a Roto-clone followed by an ESP or fabric filter. Of the three well-controlled printing plants visited in this study, two used a Roto-clone as the primary control device. Officials at these two plants reported that the Roto-clone alone did not decrease visible emissions enough to meet local standards (typically a maximum of 20% opacity). Opacity requirements were met under maximum operating conditions by addition of secondary control devices, an ESP at one plant and fiber glass panel filters at the other.

Control operations at the three plants are summarized in Sections 5.1 through 5.3. No source test data were available from which to determine whether these plants are the best-controlled hot metal operations. They were selected because they represent each of the control systems now used in the printing industry. Plant contacts and addresses are listed in Table 5-1.

5.1 DALLAS MORNING NEWS

The Dallas Morning News uses hot metal in stereotype and linotype operations. The stereotype plates used on the

Table 5-1. VISITED PLANTS' ADDRESSES AND CONTACTS

Newspaper	Address	Contact	Phone Number
Dallas Morning News	Communications Center Dallas, Texas 75222	Robert Harrison	(214) 745-8222
Detroit Free Press	321 W. Lafayette Detroit, Michigan 48231	William Langman	(313) 222-6400
Kansas City Star	1729 Grand Avenue Kansas City, Missouri 64108	Charles Rosganger	(816) 421-1200

presses are produced by four casting machines fed by a 10-ton and an 8-ton casting pot. Both pots are gas-heated. Stereo metal is pumped to these pots from a 50-ton gas-heated pot that melts used plates. The alloy is kept liquid at approximately 600°F until it is pumped to the two casting pots as required.

Other hot metal equipment includes a small electrically heated stereo pot used to melt and supply alloy for casting flat plates, a pot for melting and casting linotype alloy ingots, and a number of linotype machines with small single ingot pots. Routing equipment is available to machine the stereo plates if necessary.

The 50-ton pot is approximately 10 feet long by 4 feet wide. Used printing plates are conveyor-fed to the pot as needed to maintain the required input for the two casting pots. The pot is hooded completely; the exhaust is ducted from the plate dumping area and above the drossing area to an American Air Filter type W Number 12 Roto-clone followed by two parallel Viscon Aril series 440 cartridge fiber glass filters. The Roto-clone collects 5 to 10 gallons per week of contaminated water, which is discharged to a sewer. The fiber glass filters are changed every 3 months. The filters are included in plant waste and removed by truck. The Roto-clone was installed to prevent fires in the exhaust gases.

Since the Roto-clone did not eliminate smoke, the filter system was added. Cost data are not available.

From the master pot, liquid metal is pumped to the two casting pots, where it is maintained at approximately 650°F for casting. The pots are covered with a layer of vermiculite to conserve heat and reduce oxidation of the metal. The pots are equipped with tight-fitting hoods and are exhausted by fans directly to the atmosphere. The associated casting equipment and routing machines are not vented. The routers are covered, and the filings are collected in pans placed under them.

The stereo pot for flat casting and the small pot for casting linotype ingots are operated when needed, and each is exhausted by a fan to the atmosphere. The small pots on the linotype machines are not hooded. Tests conducted by the State of Texas in the working area of the machines indicate that lead concentrations are below the existing OSHA standard of 0.2 mg lead/m^3 of air for an 8-hour average concentration.

Dross is removed from all pots weekly. A flux manufactured by the Imperial Metal and Chemical Company is added periodically to remove impurities. The metals lost by drossing, essentially antimony and tin, are replaced by the addition of toning metal. Composition of the toning metal

is determined by analysis of metal samples, conducted by Imperial or by the Federated Metals Division of American Smelting and Refining Company.

Emissions from the controlled lead pot have never been tested. During PEDCo's visit no visible emissions were observed, even though the filters were not properly attached (they had slipped from the upper support). The stack is approximately 8 inches in diameter, with no test ports. A straight length of ductwork of about 50 feet is located between the control system and the stack outlet. The outlet directs the exhaust down toward the roof. The stack outlet showed some oily residue distilled from ink on the stereo plates.

For reasons of economics, the hot metal facilities at the Dallas Morning News will be converted within a year to a cold type process that will use plastic plates on existing printing machinery.

5.2 DETROIT FREE PRESS

The Detroit Free Press uses lead type in stereotype and linotype operations. In the stereotype operations, one 17-ton gas-heated pot receives used lead plates and melts them at a temperature of 600°F. Another pot of the same size, heated electrically, receives the overflow from the first pot. These pots hold the stereo metal in the liquid state until it is required by two 10- to 12-ton electrically

heated casting pots, in which the printing plates are cast for use on the presses. A smaller melting pot in the composing room melts used linotype and casting ingots to use as linotype machine feed. Each of the 20 linotype machines also is equipped with a pot that holds about 50 pounds of liquid alloy. Routing equipment is available for machining of stereo plates.

Dimensions of the large remelt and overflow pots are about 4 by 8 feet. Used printing plates are conveyor-fed to the remelt pot as needed to maintain a supply for the overflow pot and the two casting pots. Used plates can be fed to the overflow pot if the remelt pot is shut down. Liquid metal is pumped from each of the two larger pots to the 10- to 12-ton casting pots for casting the stereotype plates. The alloy is maintained in the liquid state in all four pots at approximately 660°F.

Each of the four stereo pots is equipped with a coarse metal filter on the exhaust. The metal filters are cleaned daily. After the filters, all four pots tie into a common water-wall scrubbing system manufactured by Buffalo Forge. Design data are not available for the system, which was installed in 1950 for fire protection. Exhaust is drawn through the scrubber by a 40-horsepower fan at 1760 rpm. Casting equipment and routers are vented directly to this

scrubbing system.

The composition-room melting pot used for melting linotype alloy and casting it into ingots is maintained at 560°F during operation. Exhaust from this pot is vented through six fiber glass furnace filters in series and then to the atmosphere. The pots on the linotype machines are uncontrolled.

Flux is added twice weekly for removal of impurities. Dross is removed at regular intervals at a rate of approximately 1 ton per week. A sample is sent to the Imperial Metal and Chemical Company for analysis. Imperial then returns toning metals to the newspaper to be added to the alloy to maintain proper proportions of lead, tin, and antimony.

Reportedly, no stack tests have been run on the hot metal facilities at the Detroit Free Press. Plant personnel know of no state or local regulations applicable to their lead type facilities.

Plant representatives have no plans to shut down the hot metal operations since they see no advantage in switching to cold type and di-litho at this time.

5.3 KANSAS CITY STAR

The Kansas City Star uses hot metal in stereotype and linotype operations. The stereotype department melts plates in two 10-ton gas-heated pots, which feed liquid

metal alloy to the casting machines. A small 5-ton electrically heated melting pot is used infrequently to melt used linotype and cast the metal into ingots to feed the linotype machines.

The two 10-ton stereotype pots are approximately 6 feet in diameter. Used printing plates are conveyor-fed to the pots as needed to maintain input for the casting operation. Liquid metal is maintained between 560 to 580°F until it is cast. After the plates are cast, excess alloy is trimmed from the plate and returned to the melting pots. Both pots, trimming saws, and a drossing barrel are hooded and vented to an American Air Filter type W number 12 Roto-clone in series with a size ECU-10 low-voltage electrostatic precipitator (ESP). The Roto-clone draws 3000 acfm and uses water at a rate of 2 gpm (L/G = 0.67 gal./1000 acf). Sometimes the Roto-clone must be manually cleaned to remove particles that settle out. Particulate is removed from the collecting plates of the ESP during a detergent cleaning cycle. Static pressure drop across the control system is reported to be 3.5 inches water gauge.

The pots are periodically drossed and fluxed to remove impurities. Metals removed during drossing are replaced by a toning metal, whose content is determined by Imperial Metal and Chemical Company from analysis of a sample of the drossing residue.

In the past, plant operators attempted to minimize smoke by washing the used plates. This proved to be exceptionally difficult, and results were unsatisfactory. Manually cleaned electrostatic precipitators were then installed. Reportedly, these ESP's were undersized and required high maintenance.

Although emissions from the controlled lead pots have not been tested, the local EPA has measured visible emissions. Before these readings, the pots were emptied and then filled with used plates. Opacities of 15 to 20 percent were measured while the plates were being melted. Similar conditions, however, would never occur during normal operation. No visible emissions were observed during the plant visit.

The exhaust stack extends about 12 feet above the roof. There are no test ports. The first 10 feet of the stack has a 17- by 25-inch rectangular cross section, which converges into an 18-inch-diameter cylindrical stack.

The printing plant at the Kansas City Star will be converted to a di-litho process by May 1976 for better production efficiency and economics. Plant officials foresee no new installation of hot metal facilities at any newspaper.

5.4 OTHER WELL-CONTROLLED FACILITIES

Table 5-2 lists many of the controlled lead type opera-

tions in the United States. No controlled operations were found among magazine publishers or small print shops. Data for this table were compiled through telephone conversations with various newspaper and magazine publishers and with local air pollution control agencies.

Table 5-2. CONTROLLED HOT LEAD TYPE OPERATIONS

Location	Newspaper	Control device	Pots controlled		Control device manufacturer[a]
			Number	Capacity, tons	
Atlanta, GA.	Constitution	Water spray and fiberglass filters	1 2	40 20	AAF
Boston, MA.	Globe	Fabric filters and Roto-clone	3	N.A.	N.A.
Buffalo, NY	News	Roto-clone	1 2	11 9	AAF
Charlotte, NC	Observer	Roto-clone	1 1 1	30 8 3-4	AAF
Chicago, ILL.	Tribune	Filters and thermal incinerator	1	100	N.A.
Dallas, TX.	News	Roto-clone fiberglass filter	1	50	AAF Aril filters
	Times Herald	Roto-clone	1	N.A.	AAF
Denver, CO.	Post	Roto-clone	1 1	10 8	AAF
Detroit, MI.	Free Press	Metal filters and high pressure spray	2 master 2 slave	15 8	Buffalo Forge Co.
	News	Roto-clone	1 master	75	AAF

[a]AAF - American Air Filter Corp.
N.A. - Not available.

Table 5-2(Continued). CONTROLLED HOT LEAD TYPE OPERATIONS

Location	Newspaper	Control device	Pots controlled		Control device manufacturer[a]
			Number	Capacity, tons	
Grand Rapids, MI.	Press	Roto-clone	1 1	15 8	AAF
Jacksonville, FL.	Times Union	Roto-clone	1	40	AAF
Kansas City, MO.	Star	Roto-clone and ESP	2	10	AAF
Louisville, KY.	Courier Journal	Fiberglass filter Paper filter (roll filters)	1 1	63 10	AAF AAF
Miami, FL.	Herald	Roto-clone	1 master	14	AAF
Philadelphia, PA.	Inquirer	Venturi scrubber		50	AAF
Phoeniz, AZ.	Republic & Gazette	Wet scrubber	1	60	N.A.
Sacramento, CA.	Bee	Roto-clone	1	15	AAF
Seattle, WA.	Times	Steel mesh filter	1	25	AAF
Washington, DC	Post	Wet scrubber	1 1	80 40	AAF

[a]AAF - American Air Filter Corp.
N.A. - Not available.

6.0 ESTIMATES OF TOTAL NATIONAL EMISSIONS

It is estimated that no new lead type printing facilities will start operation over the next 10 years. The use of lead type is declining rapidly because of advantages offered by photographic and lithographic techniques. Within the next 10 years the total emissions of lead from printing operations will be less than 10 tons per year. These emissions will come from one or two large newspaper plants still using lead type for some parts of their paper and from a few small print shops that use hot metal about once per week.

As of December 1974, there were 229 newspaper plants in the United States using hot metal letterpress stereotype.[1] Newspapers and the U.S. Government Printing Office account for over 99 percent of all hot metal type; magazines and small job printers account for less than 1 percent. At an assumed average emission rate of 2.1 lb/hr[2,3] each of the large sources emits approximately 10 tons per year of total uncontrolled particulate (including condensible hydrocarbons). If half of these plants control particulate by 80 percent and the other half is uncontrolled, the 229 plants having

hot-metal printing operations would be emitting about 1370 tons of particulate emissions. Typically, lead accounts for approximately 35 percent of the total emitted particulate.[4,5] Therefore, in 1974, approximately 480 tons of lead was emitted from the printing industry. This figure includes a 1 percent lead emission estimate for nonnewspaper printing facilities.

On the basis of these estimates and projections of future use of hot-metal typesetting processes, it is expected that lead emissions from the printing industry will decrease by about 8 percent per year until 1986.

In order to allow the Environmental Protection Agency to project the total nationwide emissions of lead from the type-metal process which can be prevented in 1986 by promulgating standards in 1976, three types of emission factors are estimated. These are as follows:

E_S = Emissions using typical existing control technology averaging in those companies which use no control. (Pound per ton of lead processed and pound per ton of lead purchased to replace that lost during remelting and reuse).

E_n = Emissions using best control technology (considering cost) for new sources (pound per ton of lead processed and pound per ton of lead purchased to

replace that lost during remelting and reuse).

$E_{111(d)}$ = Emissions using best control technology (considering cost) for existing sources (pound per ton of ton of lead processed and pound per ton of lead purchased to replace that lost during remelting and reuse).

From Figure 2-1, there will be approximately 19,000 tons/year of lead consumed as type metal in 1976. Some metal sold as type metal is used in other industries. Newspapers abandoning the type metal process sell their lead type to other newspapers. It is assumed that these sales compensate for each other so that 19,000 tons/year is used in the type metal industry. Using a metal recycle to metal replacement ratio of 330, the total lead recycled in the industry for 1976 will be 6.3 million tons.[6]

Using a simple annual growth rate of -0.083 and lead emission rates of 480 tons in 1974 and 10 tons in 1986, there will be 402 tons of lead emissions in 1976. The lead emission factors based on 1976 estimates and assuming 80 percent control of lead emissions as the best control technology (considering cost)are as follows:

E_S = 0.13 lb lead/ton of lead processed
= 42 lb lead/ton of lead purchased

E_n = 0.043 lb lead/ton of lead processed
= 14 lb lead/ton of lead purchased

$E_{111(d)}$ = 0.043 lb lead/ton of lead processed

= 14 lb lead/ton of lead purchased

Due to the relatively low lead emission rate, and the declining utilization of hot lead in printing, further study of this industry with the objective of developing air emission standards is not recommended.

6.1 REFERENCES FOR SECTION 6

1. Specification Data - 1974, Newspaper Production Equipment, ANPA Member Newspapers. American Newspaper Publishers Association Research Institute Production Department. Easton, Pennsylvania. 1974 p.S-19.

2. Source Test. Detroit News. Wayne County Department of Health Air Pollution Control Division, Detroit, 1970.

3. Source Test. San Francisco Newspaper Printing Company. San Francisco, April 13-14, 1975.

4. Detroit News, op. cit.

5. San Francisco Newspaper Printing Company, op. cit.

6. Ibid.

APPENDIX - LISTING OF INDUSTRY EXPERTS

Name	Affiliation	Address	Telephone number
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Erwin Jaffe	American Newspaper Pub. Assoc. Research Institute	P.O. Box 598, Easton, Pennsylvania 18042	215/253-6155
Fred Bratschie	American Air Filter	4505 State Line, Kansas City, Missouri 64111	816/931-2614
J. U. Gouin, Chief Metals & Chemical Division	U.S. Government Printing Office	Quality Control & Technical Dept., U.S. Government Printing Office, Washington, D.C. 20401	202/541-3000
G. L. Rothermel	Richardson Imperial Metal & Chemical Co.	Chicago, Illinois	312/656-3320